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Capstone: Sweet and Sour Experiences

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ABSTRACT

Capstone subjects are a feature of many built environment degrees. At Bond University the property, urban development, urban planning, construction management and quantity surveying specialisations share the integrative Capstone subject. Capstone students are given unique projects from industry clients who are interested in involving and releasing the capabilities of final year students on a multi-dimensional project involving facets in the areas of town planning, environmental, financial, construction, sustainability, design, social and administrative capabilities and which can be completed in 13 weeks. The project is assessed by the capstone staff as having a high research content as well as practical relevance and not just being a descriptive approach of a static situation. Students work in groups of 2, 3 or 4 (size depending on the task) with some groups working on the same client problem that has a number of dimensions and other groups working on an individual project where one analysis is sufficient. Emphasis is given to scope definition and the understanding as well as targeting of the client needs through a thorough literature review, data collection involving a range of techniques depending on the situation, analysis of the data and conclusions and recommendations. Client response to date after three years has been positive with clients requesting more involvement with this subject. Clients to date have included a major local property developer, Delfin Group, Mirvac, Billabong and Queensland Health. The positive experiences of Capstone are highlighted in this paper, which include high quality multi-disciplinary reports and presentations with student groups appreciating the benefits of integrated learning based on original research with a real project for a large private organisation. Capstone projects however can also be associated with a number of problems, possibly endemic, mainly based around the organisation of the work and from the attitudes of some of the student participants. The authors present a 'warts and all' view and discussion of capstone projects for the benefit of academics and organisations involved in these projects. Possible solutions to some of the problems are also proposed for further discussion at the conference.

KEYWORDS

capstone, integrated projects, problems benefits

WHAT IS CAPSTONE?

Based on the literal meaning of the word capstone in relation to built environments, one may conclude that capstone projects are “fixed on top of something” (Oxford University Press, 2011) and indeed this characterization delivers a remarkable resemblance to the practical role that such projects play in the educational sector. Based on the origin of the word and its elementary contemplation of the finishing elements of a particular piece of work, the concept has been extended to include not only built edifices, but also processes and activities of any kind that are in formal completion. It is this exact purpose that Capstone Projects fulfil in the world of education.

Perhaps most closely comparable to the commonly prepared tour de force required to qualify as a master craftsman in traditional occupations such as carpentry, Capstone Projects in higher education represent an ultimate application of the combined qualifications, skills and competencies that students have attained throughout their respective degrees. Regardless of the specific field, such projects should incorporate an element of practical relevance as well constituting an academic challenge above and beyond that of the often rather conceptually confined individual subjects or classes that form the components of the degrees. In a holistic and integrated fashion, such projects challenge students to demonstrate the wholehearted comprehension of the particular fields of practice, requiring a review and synthesis of the entire spectrum of acquired knowledge from their degrees. In doing so, Capstone Projects not only act as a peaking experience that allows students to increase their awareness for all things acquired throughout their degrees in synergy, but also provide a platform for the active transition from academia and education into the professional workforce.

A growing number of universities in Australia and internationally have considered the need to provide students with a ‘crowning’ academic experience that brings together the knowledge of an academic discipline or inter-disciplines and student transition to the world of work. (Holdsworth et al. 2009)

As far as the history of capstone is concerned, Gardner, et al. (1998) collected the senior year or senior year experiences (capstone) from various authors, including Levine (1998) and Cuseo (1998). These practices were noted as providing an appropriate vehicle for final year students to reflect, integrate, assess and summarise their course experiences. In fact, these courses placed great emphasis on the capstone or senior seminar experience.

Capstones are not new. Some evidence indicates that they were used as early as the eighteenth century where they were used to integrate philosophy and religion (Levine, 1978). In the 1970s Levine (1978) conducted a survey on the methods and goals of capstones and found their incidence in the universities surveyed at a low 3%, but they

could be found in 5% of institutions nationally (in the USA). Cuseo (1998) also reviewed experience with senior seminars and capstones in the USA. This work centred on analysing capstones in terms of their types, goals and form of experience. Henscheid (2000) in a national US study conducted a desktop study of various databases and discovered that most capstone courses were connected and coordinated by a particular academic discipline or department. A related national survey identified nearly 900 instances of capstone subjects in US colleges and universities. These capstones were identified as falling into one of five types:

- (a) *Discipline and Department Based* (majority of capstones) – these summarise learning within a discipline or major.
- (b) *Interdisciplinary* (second most common) – these synthesise and integrate interdisciplinary features of the courses.
- (c) *Transition* (third in popularity) – these prepare students for employment, graduate school and life after university and often involve career staff and external professionals.
- (d) *Career Planning* (least common) – these encourage professional engagement using university career staff and others.
- (e) *Other* (smallest group) – ones that do not fit into the types above and often these span courses, majors and often aim at addressing university goals.

The capstone at Bond University would primarily fall into the interdisciplinary category noted above, but there is also an element of career planning involved with the professional and industry engagement facilitated by the projects selected. Furthermore, given the involvement of students with external professionals as well as potential future employers in the scheme of the capstone project at Bond University, it may also be seen to reflect an element of transitionary nature, thereby striking another of Henscheid's categories. The practical necessity of stepping beyond this classification and facilitating extended and further integrated projects will be illustrated in the later sections of this paper.

CAPSTONES IN AUSTRALIA (A SHORT REVIEW)

There are a number of documented capstones in Australia, not all of which are in the built environment:

- Flinders University, Adelaide in some graduate courses. See <http://www.flinders.edu.au/teaching/quality/teaching-methods/teaching-final-years.cfm>

- Curtin University, Perth in the Business School. See <http://www.business.curtin.edu.au/business/current-students/unit-and-course-information/business-capstone-unit>
- Swinburne University, Melbourne in the Business School. See <http://www.future.swinburne.edu.au/student-life/why-swinburne/capstone-projects/>

A study from the University of Melbourne has documented (Holdsworth et al. 2009) several capstone projects in five Faculties:

- Project Planning Studio, Faculty of Architecture, Building and Planning;
- Business Practicum (3rd year), Faculty of Economics and Commerce
- Capstone Design projects (System Modelling & Design), Melbourne School of Engineering
- Experimental Research project (Zoology), Faculty of Science
- Knowledge Transfer Project, Case Competition (Marketing), Faculty of Economics and Commerce

The same University of Melbourne study provided details of some significant capstone subjects based on various approaches to completing the capstone at a number of other universities, many of which are overseas. The ones noted were:

- Internship Experience, London School of Economics and Political Science
- Virtual Situated Learning Environment Case Study, RMIT School of Management and IESEG School of Management, University of Lille, France
- Master of Public Administration Capstone, London School of Economics and Political Science, School of Business

Baccarini (2009, 2010) has also documented the planning and implementation of capstone projects in similar built environment educational programs to the one described by the authors at Bond University and in a similar action research approach to the one adopted in this paper.

TYPES OF CAPSTONE

Capstones can be based on a number of approaches. Moore (2008) summarised three basic ones as follows:

- Students are presented with a problem and draw upon their knowledge and research to weigh and select various data leading to a solution of the problem which is workable and intellectually defensible.
- The approach and decisions made reflect attitudes, values, feelings and beliefs characteristic of the discipline and the profession.

- The production of a project, solution to a problem and the oral and visual presentation of it, reflects a degree of skill competency as a communicator.

Holdsworth et al. (2009) describe the types of capstone that capture these approaches to include:

- Problem Based Learning (PBL)
- Project Based Learning (PjBL)
- Case Study Analysis
- Field, clinical or work placements
- Internships
- Simulations or Virtual Situated Learning Environments (VSLE)
- Travel study tours and immersion experiences
- Service Learning
- Volunteering

The number and types are diverse and aimed to satisfy the teaching objectives of specific courses and it would be incorrect to describe capstone subjects as ‘one size fits all’. Program coordinators and lecturers need to identify the specific aims and objectives of the capstone they wish to design for their individual course and continuously alter the program design and challenges to meet the contemporary context and the requirement to engage students purposefully within this.

The Bond University capstone subject has elements of the various types of capstone noted above and specifically it is:

- A final year, final semester subject.
- Enabling students to apply a range of knowledge and skills sets to a partially structured industry and profession based problem.
- Designed to promote program consistency and relevance of the chosen major.
- An important exercise in testing the student’s communication and research skills and other graduate capabilities and attributes.
- Aimed to integrate and combine knowledge, skills and learning from previous semesters and subjects across a range of different topic areas. This allows students and lecturers to connect their previous studies and learning. (Huber and Hutchings, 2004).
- Supporting graduate career choices and prepares students for the transition between final semester studies and their employment selection.
- Providing potential employers with examples of student work in their employment related areas and demonstrates their problem-solving capabilities and performance.

- Useful and necessary for students to be confronted with a controlled real-world professional environment and one they can reflect on with their peer review and personal diaries.
- Useful for students within their groups and between groups to appreciate a sense of common purpose and working together as a community tackling a common problem.
- A means by which other staff can judge the effectiveness of their subjects in preparing students for integrated project work and the capstone provides a suitable vehicle for some staff to contribute their subject expertise to the project.

CAPSTONE AT THE INSTITUTE OF SUSTAINABLE DEVELOPMENT AND ARCHITECTURE (ISDA) AT BOND UNIVERSITY

Bond University's Institute of Sustainable Development and Architecture has developed a unique approach to the Capstone Project that seeks to synergistically combine the individually potent elements of academic rigor, professional practice and practical relevance. Through continuous refinement in the objectives and methodologies used in the selection, preparation and execution as well as critical review of the Capstone Projects, the program has arrived at a level of maturity that provides for the achievement of a variety of conceptually interlinked, yet practically often neglected, goals in education. The ISDA Capstone Projects provide benefits beyond the student and learning experience by means of contributing effectively and beneficially to real-life projects, whereby fostering closer ties between the academic and the professional spheres. This leads to a regular interplay between academia and practice creating mutual benefits for all involved.

Whilst common models of Capstone Projects rely purely on research or hypothetical reproductions of real-world scenarios, Bond University's industry oriented philosophy and its track record of successful collaborations with external organizations, businesses and entities has promoted a suitable environment for the creation of educationally focused as well as practically integrated student projects. In its 4th year (12th trimester) of operation, the Capstone Project program at Bond University has provided a platform for and continues to deliver added benefits on selected projects to a multitude of organizations, including amongst others, Gold Coast City Council, Billabong International, Queensland Health, Emerald Shire Council, Point Project Management, Delfin Lend Lease and the Varsity Lakes Community Ltd. Positive feedback from many of the project partners has demonstrated that the Capstone Projects not only provide a practically placed opportunity for applied learning to the students, but have also catered

for the requirements of the increasingly complex world revolving around the built environment.

In a recent debriefing for a Capstone Project with members from the Mirvac Group (another continuing partner for Bond's Capstone Projects), it was mentioned that:

... working with Bond University, under the heading of the Capstone project, provides us with vital and powerful research and knowledge. This type of intensive and objective research and analysis is often sacrificed in practice due to time and monetary constraints, but it is essential as it not only allows us to make better decisions, but in many cases provides us with the convincing supporting arguments to make more sustainable improvements to our developments.

This statement demonstrated the distinct value that the Capstone project can provide to create better built environment outcomes and provide commercial partners with the required knowledge and research to make better decisions in the real world.

At Bond University's Institute of Sustainable Development and Architecture, the approach taken to Capstone Projects is one of multifaceted and multidimensional interaction that promotes creativity, self awareness, team working abilities, outcome oriented working and learning as well as the practical applicability and usefulness of produced results. The cornerstone in the achievement of these essential end results rests with the integration of the various built environment related disciplines to which the ISDA offers relevant degrees. These include construction management and quantity surveying, urban planning and design, urban development and sustainability, property and property valuation as well as architecture and environmental management. In a process equivalent to the professional assembly of a project team for the execution of a real-life assignment, during which students are required to promote themselves and their own abilities in an interview-like scenario, teams are designated based on aspects such as discipline of study, interests, maturity, practical experience and team-leading capacity. Whilst teams, in accordance with the Capstone Project philosophy at Bond University, are intentionally multidisciplinary in nature, they are assembled in such a way as to ideally suit the given project/s at hand and to create optimal and creative outcomes.

Representatives from the industry partner organizations are also involved in formulating the conceptual frameworks laying out the most appropriate way in which their particular set of knowledge and skills can provide the most significant contribution to the projects at hand. Given the diversity of the projects as well as the backgrounds of the individual students and groups, there is significant variation in the particular areas that will be investigated and in which students will make recommendations to the industry partners even within the same semester. Through the preparation of a detailed project scope

document prior to the practical commencement of any study, the particulars of the work that is to be executed by the students is specified. The scope also includes roles, responsibilities as well as milestones and ultimate objectives, whereby the practical feasibility and relevance of the projects is assured. This process not only provides a common understanding between partnering organizations, the academic staff and the students, but it also enables and ultimately empowers students to increase their own awareness of their capacity to contribute to real-life projects towards the end of their degree. In doing so it provides students with confidence and assurance of the worth of their studies in the achievement of their own goals in their professional careers.

Upon the completion and authorization of the scope documents and potential sectional adaption, students enter the period of focused research and analysis. During this period, academic staff provides relevant advice on the design and execution of the pertinent methodologies, relating insight in regard to information finding and synthesizing as well as the preparation of a professional semi-academic report. In this context, the term semi-academic relates to the mixture of an academic and a professional consultant report that the ultimate Capstone Project report is intended to constitute. These reports serve the dualistic purpose of informing the client of the work executed by the students as well as any recommendations that arose from such reports, whilst also epitomizing the essence of academic standards and work as learned by the students throughout their degrees. Whereas the expectations of the industry partners are commonly based around convenience and easy navigation of the reports, the academic requirements, such as appropriate referencing and formatting of the reports must not be neglected. As can be expected, the 'problem of two masters' creates a challenging scenario that must be met with a dedicated focus towards the ultimate goal of providing synergistic outcomes in both the academic and professional realm. Whilst certain compromises may need to be made in the process of preparing reports for these multi-layered expectations, the importance is that the essence of the purposeful integration of the reports in both spheres is not compromised.

In the final stages of the Capstone Projects, the student groups are asked to find the most appropriate form of relating their information to the partnering organizations. Even though the common format is the preparation of a report and associated presentation that summarises the content of the earlier, experience has shown that by providing students with an adequate platform and an open mindset, creativity is spurred and ever new means are found to effectively communicate concepts and findings. At Bond, this has been brought about, amongst others, the construction of both virtual and physical display models, the integration of various illustrative props, interactive web-based tools as well the formation of community based activities. The diversity of communication and

delivery methods is matched only by the diversity of student backgrounds, their creativity and the application of their skills in the respective projects.

The final completion of Capstone Projects at Bond University's Institute of Sustainable Development and Architecture involves a full project debriefing during which students are encouraged to exchange the lessons that they have learned whilst working on their individual projects as well as throughout their degrees and the practical value that they have gained from such work for their future careers in the field. At this stage, the industry partners also provide feedback on the work of the students as well as the relevance that the Capstone Project has or is likely to be associated with in the real-life built environment related projects. By means of this process, an interactive dialogue is usually generated that provides valuable insight on the linkage between academia and practice as well as the transition of students from education into practice.

A brief summary and illustration of projects completed, or in progress, to date are included in Table 1.

Table 1 – The Capstone projects

Industry Partner	Project	Illustration
Billabong	International Headquarters	
<p>Billabong International is a multifaceted business with active operations in various fields, including the “marketing, distribution, wholesaling and retailing of apparel, accessories, eyewear, wetsuits and hard-goods in the board-sports sector”. After the recent acquisition of a significant land parcel adjoining their existing international headquarters in Burleigh Heads, Queensland, Billabong approached Bond University for the inception and preparation of integrated and sustainable development plans for a new ‘board-sport precinct’ to be formed on the combined sites.</p>		
Mirvac Group	Bromelton Intermodal Hub	
<p>Representatives from the Mirvac Group, one of Australia's leading real estate groups and sponsoring partner to Bond University's School of Sustainable Development, approached Bond University for the instigation of a Capstone Project based on a current intermodal hub development at Bromelton, Queensland. Students were asked to contribute to the project in a variety of areas including sustainability, transport efficiency and planning, strategic synergies, land use planning, development staging and international benchmarking.</p>		

<p>Varsity Lakes Community Ltd.</p> <p>Boathouse</p> <p>Varsity Lakes Community Ltd., a non-for profit organization in charge of community development and the oversight of community assets and activities in Varsity Lakes, Queensland, has collaborated with Bond University on several occasions. In a Capstone Project, students supplied valuable background research and insight to improve the delivery of a \$1.8 million community sport house facility. Amongst others, students investigated building materials, strategic alliances and partnering, value adding and income generating uses on the site, funding and grant schemes as well as sustainable inclusions for the facilities.</p>	
<p>Gold Coast City Council</p> <p>Southport/Light rail</p> <p>The strategic planning department of Australia's second largest council, the Gold Coast City Council, collaborated with Bond University on a Capstone Project relating to the master planning of one of Gold Coast's central business districts, Southport, in 2010. In the project, students were asked to evaluate a recently prepared draft master plan and make recommendations on its improvement. Students also prepared strategies to increase resident acceptance and usage of the planned light rail as well as proposals for transit oriented developments in the area.</p>	
<p>Point Project Management</p> <p>9 Mile Development</p> <p>Members of staff from Point Project Management, including three alumni from Bond University's Institute of Sustainable Development and Architecture, are currently involved with the execution of a Capstone Project based on a development in Papua New Guinea managed by the firm for a local superannuation fund. The project, which involves the creation of a sustainable and affordable housing community close to Port Moresby, requires students to investigate matters relating to infrastructure delivery, project staging, housing designs and construction materials, project feasibility and community safety as well as active transport strategies.</p>	

FORMAL AIMS AND OBJECTIVES OF THE BOND UNIVERSITY CAPSTONE SUBJECT

The primary aim of this subject is to demonstrate knowledge of the major streams undertaken during the individual degrees including, construction management and quantity surveying, facilities and event management, urban planning and design, urban development and sustainability, property and property valuation as well as architecture and environmental management. The teaching approach is practical emphasising sound

practice, innovation and understanding the role of the various stakeholders influencing the nature and form of development in the built environment. Emphasis is given to teamwork and integration of the disciplines within the framework of the project or problem being analysed.

Extracts from the subject outline of the capstone within the School of Sustainable Development are provided below:

Subject Aim

This subject provides an opportunity to undertake an inter-disciplinary investigation of a built environment related project, bringing together a student's understanding of sustainable best practices, evaluation, design, investment analysis, planning, development, life cycle costing and financing in a real world project. Furthermore, students are encouraged to demonstrate the diversity of their knowledge gained from formal and informal learning throughout their degrees.

Subject Objectives

On completion of the subject students should be able to:

- Distinguish the various stages of property development from business case, needs analysis, construction methodology, ownership of buildings and life cycle analysis.*
- Develop recommendations and justify using various measurable cost and other benefits or advantages.*
- Conduct case study investigations to justify their analysis, drawing on other sustainable buildings and research in the area of investigation.*
- Be able to plan and execute an integrated project.*

EXPERIENCES AND CRITIQUE

The authors have been involved with the Bond University capstone for the last three years and their experiences are summarised below as part of an action study research approach. Additionally, the capstone students are surveyed at the end of each semester for their views and opinions and these have also provided the basis of the summary provided for the sweet and sour components of the subject.

Benefits (sweet)

Capstone has the following significant benefits:

- Draws together disciplines (construction management and quantity surveying, urban planning and design, facilities and event management, urban development and sustainability, property and property valuation as well as architecture and*

environmental management) to establish closer links between areas of skills, knowledge and environmental context in the various majors;

- Provides a significant and different opportunity to assess and evaluate the students' learning in a context related to their chosen majors, a professional environment and in many cases operating with imperfect information;
- Gaps in knowledge and skills become apparent in this project environment where the capabilities of the student are often tested to the limit;
- The expectation is that students work and perform at a higher level due to group activities, the involvement of external clients and the need to present a professional report based on research, analysis, evaluation and recommendations. Business engagement, which is a feature of the Bond University capstone, generates high performance due to the desire to impress the client(s) especially through the interim and final presentations to the client group.

Disadvantages (sour)

- Assessment of performance can be difficult when the project can contain several dimensions that each group may tackle uniquely and the overriding concern of the assessors (internal and external) is to remain objective and not be too prescriptive in assessing the outcomes;
- Some students find the capstone environment outside their 'comfort' zone and may react badly to tackling a real world project where a 'right' answer cannot be provided, nor expected. Students lacking motivation need attention and coordinators need to be mindful and vigilant that poor performing students in a group can be disruptive and early intervention measures have to be adopted to solve these emerging problems.
- Coordinators must have great sensitivity to the volatile environment as individuals and groups can feel helpless and stressed about the requirements to successfully complete the project. Previously high performing students as well as the less motivated can suffer from this problem and intervention in the form of confidence building or project and scope clarification are necessary immediately when this becomes apparent;
- Problems can emerge if regular briefings, progress meetings and progressive evaluation methods are not established in the program and assessment regime;
- In extreme cases some students may not have the capability to complete the task within a group and coordinators must have a strategy to cope with the situation to the satisfaction of all concerned;

- Students often complain of the great demands on their time for the capstone and careful management as well as timely and appropriate advice are needed to cope with these complaints;
- High expectations are embedded in the capstone project and this may disturb some lesser performing students. Early intervention and advice are essential where these comments are made by students;
- Strategies for coping with failure and problems are unlikely to be straightforward or prescriptive. Each situation has to be handled taking account of the circumstances and the individual(s) and separate resubmissions may be necessary and only in the extreme cases of non-performance would failure be accepted;
- Levels of performance between individuals and groups are always difficult to assess and specific as well as absolute levels of performance can be difficult to document in advance.

CONCLUSION

The Capstone subject is demanding of staff and student time and requires detailed management and organisation for it to succeed. The subject is a risky one in terms of its outcome as the staff cannot control a large number of the variables in the subject and the final outcome. In fact, there may be times when staff are faced with a situation where they have to rely on the goodwill of the industry sponsors of the project, the faith of the students and mine their own problem-solving skills to ensure that the project can be completed and the subject aims and objectives are achieved. Staff and students have to be versatile, flexible, forgiving and innovative if their project is to be completed to a satisfactory standard. There have been a few occasions when the road map at the start of the project briefing process has had to change as a result of exogenous factors, some benign, some serendipitous and others negative. Whilst some students may find this environment too challenging causing them to complain because they are taken out of their comfort zone for their studies, the vast majority begin to appreciate that not all projects have complete or perfect information and part of their role as professionals is to cope with this situation. This is the message students take with them into practice and in the opinion of the authors this is good training for the volatile world they will find themselves in soon enough.

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